

REMARKS/ARGUMENTS

In response to the Final Office Action dated November 16, 2005, the applicants have amended Claims 2, 4-9, 11 and 13 as well as cancelled Claims 10, 29, 33-35 (along with previously cancelled Claims 1 and 15-28). All said cancellations being made without prejudice. Entry of the above amendments and reconsideration of the application in light of the amendments and comments made herein is requested.

Amendments to the Specification:

Certain informalities have been addressed in the Specification. Paragraphs [0024], [0027] and [0032] have been amended to correct the indicated typographic errors.

Rejection of the Claims Under 35 U.S.C. § 102:

All Claims have been rejected as anticipated by a number of different references. In response, Claim 2 has been further amended to address the issues presented by the Examiner. A detailed explanation the reasons why Claim 2 overcomes the prior art is set forth in detail below.

Bunyan

Claims 1-4, 9, and 29 are rejected under 35 U.S.C. § 102 as being anticipated by *Bunyan* (USPN 6,432,497 hereinafter "*Bunyan*").

Claim 29 is cancelled making moot this ground of rejection.

Claim 2 recites "a first layer of thermally conductive reflowable material formed on the top surface of the core" and also "a second layer of thermally conductive reflowable material formed on the bottom surface of the core". There is no layer of reflowable material taught by *Bunyan*. Accordingly, the *Bunyan* reference does not teach all elements of Claim 2. This should clear up any concerns of the Examiners concerning 37 C. F. R. 1.111(b).

In one particularly relevant portion of the Office Action (e.g., at p. 11 heading 10), it is stated that *Bunyan* teaches "a first layer 20 of a thermally conductive reflowable material formed on the top surface". Additionally, the Action offers that *Bunyan* teaches "a second layer 18 of a thermally conductive reflowable material formed on the bottom surface". The applicants respectfully disagree with this interpretation of *Bunyan*. *Bunyan* is very clear about what elements 18 and 20 are and it is not layers of reflow material. *Bunyan* states that 18 is a bottom

surface of dissipation member (heatspreader) 22. Specifically, a "second heat transfer surface 20 of a dissipation member 22" (*Bunyan* at 9:66, 10:15-20 and so on). Additionally, *Bunyan* states that 20 is a top surface of the die 12. Specifically, "the first heat transfer surface 20 of component 12" (*Bunyan* at 10:33, 10:15-20 and so on). Accordingly, the *Bunyan* teaching is that 18 and 20 are surfaces of other elements and not layers of reflow materials as asserted in the action. Thus, *Bunyan* fails to achieve a *prima facie* case of anticipation and should for that reason be withdrawn.

However, in an effort to clearly illustrate certain patentable distinctions between the cited art and the claimed invention, the applicants point to certain amendments to Claim 2. Claim 2 is amended to include "a core spacer plate" having "a first layer of thermally conductive reflowable material formed on the top surface of the core" (emphasis added) and also "a second layer of thermally conductive reflowable material formed on the bottom surface of the core" (emphasis added). *Bunyan* relies a "compliant and conformable" "interface 30" (*Bunyan* 10:10-12) enclosed by pressure sensitive adhesive (PSA) layers 36, 38 (*Bunyan* 12:22-25) there is no teaching of a stiff core plate nor of reflowable materials. The PSA materials taught are specifically, silicone and polymeric adhesive (*Bunyan* 11:14-29). These are not solder.

Respectfully the applicants submit that *Bunyan* does not teach the claimed invention.

To further clarify, the applicants go further in amended Claim 2 to recite that:

"the reflowable materials comprises a solder from the group consisting of silver containing solders, tin containing solders, lead containing solders, silicon titanium containing solders, tin silver containing solders, and tin bismuth containing solders".

This is also different from *Bunyan* which requires a double sided interface that requires pressure sensitive adhesive (PSA) to adhere the heatspreader 24 to a die 12 (See, *Bunyan* at 6:34-7:4; 9:30-35; and elsewhere). In particular, the PSA layers 36 and 38 are not the same as the reflow solder materials taught by the present invention.

These materials and structural distinctions are important because they provide advantages over devices such as are taught in *Bunyan*. For example, in *Bunyan*, significant processing time, effort, and money are lost preparing the devices for pressure treatment to adhere the die to the heatsink. The claimed invention dispenses with all of this wasted time and effort. In fact, in some embodiments, die attach, stiffener mounting, and heat sink attachment can be accomplished all in one reflow step. This is not possible using the *Bunyan* technology. Moreover, the *Bunyan* technology creates thick thermal layers between the die and heatspreader relative to the claimed invention thereby increasing overall package thickness. For example,

Bunyan teaches that the layers 36, 38, 42 are arranged with an absolute minimum thickness of about 50 micron. Whereas the maximum thickness of the claimed invention is about 30 micron with average thicknesses commonly in the range of 12 micron or less. The *Bunyan* reference cannot produce layers this thin. Thus, it is unsuitable for the intended purpose of the invention and is therefore an inapplicable reference.

Accordingly, for at least these reasons, the applicants have shown that the cited art is missing certain claimed elements (i.e., the reflowable first and second layers and also the core plate) and is incapable of achieving the thin profile of the claimed invention and is therefore insufficient to establish a *prima facie* case of anticipation relative to Claim 2. As a consequence, the applicants request that this ground of rejection be withdrawn and Claim 2 be allowed.

Moreover, as to dependent Claims 3, 4, and 9 all of these claims are dependent on Claim 2. Each of these claims has separate grounds for allowance. However, due to the failure to establish a *prima facie* case of anticipation of base claim 2 it is not necessary to discuss the details of the dependent claims at this time.

Chen

Claims 2, 4, 5, 7, 8, 10, and 11 are rejected under 35 U.S.C. § 102 as being anticipated by *Chen et al.* (USPN 6,716,676 hereinafter "*Chen*"). As to Claim 10, this ground of rejection is made moot by the cancellation of Claim 10.

As to amended Claim 2, the applicants point out that *Chen* does not teach a multi-layer heat transfer element arranged between the semiconductor die and the heat spreader including "a first layer of thermally conductive reflowable material formed on the top surface of the core and directly above the die attaching the core to the heatspreader" and "a second layer of thermally conductive reflowable material formed on the bottom surface of the core to attach the core to the top of the die".

The multi-layer heat transfer element of *Chen* is NOT arranged between the die 320 and the heatspreader 370 of *Chen* as asserted in the Action (See, *Chen* Fig. 7). In particular, *Chen* does not include "a first layer of thermally conductive reflowable material formed on the top surface of the core and directly above the die attaching the core to the heatspreader" (emphasis added). Thus, this element is not present in *Chen*. Thus, *Chen* fails to teach all of the claimed elements of Claim 2. Accordingly, *Chen* is insufficient to establish a *prima facie* case of anticipation as to Claim 2.

Additionally, there is no core in *Chen*. The Action asserts that *Chen* element 332 is a core. The applicants respectfully disagree. *Chen* states (at 5:10-21) that element 332 is in fact

an overhead portion of a heatspreader and therefore is not the core between two thermal layers enabling thermal contact with a heat spreader as suggested in the Action.

Additionally, there is no indication that a reflow material is used to attach the die to the heat spreader and core as required by the claims. The only indication of as to what these materials are is at *Chen* 4:23-49 and the later description of element 375 which indicate adhesive or conductive materials but do not teach reflow materials. Since solder (a reflow material) is discussed elsewhere in the *Chen* specification it is reasonable to expect that it would be disclosed as the adhesive element if that is what the inventors intended. This point is made more explicit in the amendment of Claim 2 which recites "reflowable materials comprises a solder from the group consisting of silver containing solders, tin containing solders, lead containing solders, silicon titanium containing solders, tin silver containing solders, and tin bismuth containing solders". This limitation is also absent from *Chen*.

Accordingly, for at least these reason, the applicants have shown that the cited art is missing claimed elements and is therefore insufficient to establish a *prima facie* case of anticipation relative to Claim 2. As a consequence, the applicants request that this ground of rejection be withdrawn and Claim 2 be allowed.

Moreover, as to dependent Claims 4, 5, 7, 8, and 11, all of these claims are dependent on Claim 2. Each of these claims has separate grounds for allowance. However, due to the failure to establish a *prima facie* case of anticipation of base claim 2 it is not necessary to discuss the details of the dependent claims at this time.

Karnezos

Claims 2-10, 12, and 13 are rejected under 35 U.S.C. § 102 as being anticipated by *Karnezos* (USPN 6,906,416 hereinafter "*Karnezos*"). As to Claim 10, this ground of rejection is made moot by the cancellation of Claim 10.

As to Claim 2, the applicants point out that Claim 2 is distinct from *Karnezos* on several grounds.

For example, Claim 2 recites generally a die mounted on a substrate ("a semiconductor die mounted ... on the substrate using solder balls"). This would be die 514 mounted on substrate 512 of *Karnezos*. It is interesting to note that the Action does not assign a number to the a substrate (Office Action at 4: 13 or 10: 21). There is a reason for this. It is because the Action uses the substrate 512 (upon which the die 514 is mounted) as the multi-layer heat transfer element. Unfortunately, it 512 is used as substrate it is improper to use it as a multi-

layer heat transfer element because then *Karnezos* teaches an invention that is not claimed because the claimed invention requires both elements.

As an aside, *Karnezos* teaches a die 514 attached to substrate (512) using adhesive and electrically connected with the substrate 512 (or 412) using wire bonds 416, 516, and 518. It does not by any stretch teach attachment to a “substrate using solder balls arranged between the semiconductor die and the heat spreader to enable thermal communication between the die and the heat spreader”.

Most importantly, *Karnezos* does not teach “a second layer of thermally conductive reflowable material formed on the bottom surface of the core to attach the core to the top surface of the die”. Any configuration of *Karnezos* always involves the bottom surface of a die being in thermal communication with the heatspreader, never the top as claimed in Claim 2.

The applicants again point out that *Karnezos* does not include a multi-layer heat transfer element arranged between the die (e.g., 513) and the heatspreader 530 of *Karnezos* as asserted in the Action. For example, the Action asserts that elements 521, 512, 523 are a multi-layer heat transfer element. However, a closer review of *Karnezos* shows that this is not true. In *Karnezos* element 512 is a package substrate (See, *Karnezos* at 17:2-10) such as dies are commonly mounted on. The claimed invention has such a substrate (See, 101 of Fig. 2a, for example). Accordingly, element 512 is not a core as claimed in the invention. Moreover, the element 512 is not attached to the die 514 using “a second layer of thermally conductive reflowable material formed on the bottom surface of the core to attach the core to the top surface of the die” as required by Claim 2. In *Karnezos* the die is attached to the substrate 512 using an adhesive 513 (See, *Karnezos* e.g., Fig 5A, 17: 47-49). Thus, in *Karnezos* the die is not attached to the core using the claimed “conductive reflow material”. It is attached using adhesive layered on top of standard patterned metallization layers that electrically connect to various elements on the die (See, *Karnezos* at 17:5-7). The Action offers no teaching in *Karnezos* to support the statement that *Karnezos* elements 521 and 523 are layers of reflowable material. Absent any such affirmative teaching or suggestion in the cited art, the Examiner has not met his burden of showing that the cited art teaches all the claim limitation and has therefore not established a *prima facie* case of anticipation. Accordingly, the Examiner is invited to show some teaching in the prior art to support these assertions.

As is known to those having ordinary skill in the art it is impossible for such patterned metallization interconnects to be reflowable. Reflowable metallization layers result in the traces melting and flowing during a reflow process (that is the nature of a reflow process). Thus, the trace patterns would flow and possibly interconnect causing short circuits and misconnections

making the device inoperative. The applicants respectfully request that if the Examiner has ANY art teaching to the contrary that he please provide it.

Accordingly, the applicants respectfully submit that the cited art does not teach all of the required elements of Claim 2. Therefore, the asserted art fails to establish a *prima facie* case of anticipation relative to Claim 2. As a consequence, the applicants request that this ground of rejection be withdrawn and Claim 2 be allowed.

Moreover, as to dependent Claims 3-9, 12, and 13, all of these claims are dependent on Claim 2. Each of these claims has separate grounds for allowance. For example, there is no teaching that layer 512 is a conductive layer. The proffered paragraph at 16:13-38 merely teaches that metal layers can be placed inside polyimide or ceramic laminate to establish metallization contact through the substrate. Thus, the layer 512 is not conductive but has conductive paths through it. This is not the same as "conductive". However, the applicants assert that the cited art is insufficient to establish a *prima facie* case of anticipation of base claim 2, and accordingly, it is not necessary to discuss the details of the dependent claims at this time.

Oman

Claims 2-3 and 10-12 are rejected under 35 U.S.C. § 102 as being anticipated by *Oman* (USPN 6,873,043 hereinafter "*Oman*"). As to Claim 10, this ground of rejection is made moot by the cancellation of Claim 10.

As to Claim 2, this claim has been amended to point out specific distinctions between the cited art and the claimed invention. From bottom up the claimed invention includes as substrate having a die mounted thereon, "a second layer of thermally conductive reflowable material formed on the bottom surface of the core to attach the core to the top surface of the die", a core, "a first layer of thermally conductive reflowable material formed on the top surface of the core and directly above the die configured to attach the core to the heatspreader", and a heatspreader. This is different from the teaching of *Oman* (e.g., as shown in Fig. 1) which requires a die 12, solder connections 48 (*Oman* 4:64-66), metal sheet 34 (*Oman* 4:15-20), insulating layer 36 (*Oman* 4:19-21), metal sheet 38 (*Oman* 4:15-20), thermally-conductive lubricant 46 (*Oman* 5:43-45). As can be seen, *Oman* requires a good deal more components than does the claimed invention. The present invention does not include a die attached to a core with solder which is then attached to a heat sink. The present invention has dispensed with solder connections 48 and thermally conductive lubricant 46 and thereby establish a simplified structure that accomplished the same task as the prior art. The applicants respectfully, submit that this is *de facto* patentable over the cited art.

Moreover, the applicants respectfully submit that the Examiner has provided no art in support of his contention that copper sheets are equivalent to reflowable solder connections. Thus, the burden still remains on the Examiner to establish this. Accordingly, for at least these reasons, the applicants respectfully submit that the cited art is missing certain claimed elements (i.e., the reflowable first and second layers) and that the claims omit some elements of the prior art. Consequently, the applicants respectfully submit that *Oman* insufficient to establish a *prima facie* case of anticipation relative to Claim 2. As a consequence, the applicants request that this ground of rejection be withdrawn and Claim 2 be allowed.

Moreover, as to dependent Claims 3, 11, and 12, all of these claims are dependent on Claim 2. Each of these claims has separate grounds for allowance. However, due to the failure to establish a *prima facie* case of anticipation of base claim 2 it is not necessary to discuss the details of the dependent claims at this time.

Dyckman

Claims 2-6, 10, 12, and 14 are rejected under 35 U.S.C. § 102 as being anticipated by *Dyckman et al.* (USPN 6,657,864 hereinafter “*Dyckman*”). As to Claim 10, this ground of rejection is made moot by the cancellation of Claim 10.

As to Claim 2, this claim has been amended to more clearly identify the distinctions between *Dyckman* and the claimed invention. For example, Claim 2 recites a multi-layer heat transfer element having:

“a core spacer ... arranged solely between the die and the heatspreader”.

This is different from *Dyckman* which requires a rather large “lid 50” that extends far beyond the die and heat spreader to define a heat “path 3-4-5-6-7-8” from die to substrate 30 and further into the PCB board 40 (See, *Dyckman* at e.g., Fig. 2, and 6:32-44, and so on). Unlike the claimed invention, the core of *Dyckman* extends beyond the die and heat spreader and is therefore not confined to being “arranged solely between the die and the heatspreader”. It is necessary for the Dyckman lid to extend far beyond the die and heatspreader to make contact with the ceramic board to accommodate the heat transfer path. This is not the case with the claimed invention. Accordingly, the applicants respectfully submit that the cited art fails to teach all elements of the claimed invention and as such fails to establish a *prima facie* case of anticipation.

Additionally, *Dyckman* requires that, on either side of element 50, an elastomeric material 62, 63 be used to adhere the heatspreader 70 to a die 20 (See, *Dyckman* at 5:45-65; and elsewhere). In particular, the elastomeric layers 62 and 63 are not the same as the reflow

materials taught by the present invention. Elastomers are not solder (in fact they are "silicone adhesive such as GE 3281"; see, *Dyckman* 5:50-55) as claimed in the present invention. Accordingly, the applicants respectfully submit that the cited art fails to teach this additional element of the claimed invention and further fails to establish a *prima facie* case of anticipation.

Accordingly, for at least these reasons, the applicants have shown that the cited art is missing certain claimed elements (i.e., core configuration and the reflowable first and second layers) and is therefore insufficient to establish a *prima facie* case of anticipation relative to Claim 2. As a consequence, the applicants request that this ground of rejection be withdrawn and Claim 2 be allowed.

Moreover, as to dependent **Claims 3-6, 12, and 14**, all of these claims are dependent on Claim 2. Each of these claims has separate grounds for allowance. However, due to the failure to establish a *prima facie* case of anticipation of base claim 2 it is not necessary to discuss the details of the dependent claims at this time.

Thus, for at least the reasons explained above, the applicants assert that the cited art fails to establish a *prima facie* case of anticipation as to Claims 3-6, 12, and 14. Accordingly, the applicants request that the pending rejections be withdrawn.

Rejections Under 35 U.S.C. § 103

Claims 30-35 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Bunyan*. As to Claims 33-35, these grounds of rejection are made moot by the cancellation of Claims 33-35.

Claims 30-32 all depend directly or indirectly on Claim 2. Due to the failure of *Bunyan* alone as described above (i.e., the absence of reflow material and a rigid core plate as well as an inability to form packages that are thin enough to accomplish the purposes of the invention) the cited art fails to also teach each of the limitations of the claimed invention. Accordingly, such failure of the cited art comprises a failure to establish a *prima facie* case of obviousness as to each of the dependent Claims 30-32. Therefore, the applicants request that this rejection be withdrawn and that these claims be allowed to issuance.

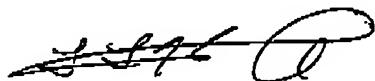
Conclusion:

In view of the foregoing amendments and remarks, it is respectfully submitted that the claimed invention as presently presented is patentable over the art of record and that this case is now in condition for allowance.

Accordingly, the applicants request withdrawal of all pending rejections and request reconsideration of the pending application and prompt passage to issuance. As an aside, the applicants clarify that any lack of response to any of the issues raised by the Examiner is not an admission by the applicants as to the accuracy of the Examiner's assertions with respect to such issues. Accordingly, applicants specifically reserve the right to respond to such issues at a later time during the prosecution of the present application, should such a need arise.

As always, the Examiner is cordially invited to telephone the applicants' representative to discuss any matters pertaining to this case. Should the Examiner wish to contact the undersigned for any reason, the telephone number set out below can be used.

Respectfully submitted,
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